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(Centre of Excellence in Environmental Economics)

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Contents...

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From the Director's desk...

Natural resources can be considered national assets which provide a stream of services in perpetuity if they are well maintained.However, if these resources are allowed to degrade , their productivity falls affecting the overall welfare of the society.In this isuue, Dr. G.Mythili explains how the degradation of land due to agricultural activities has resulted in problems like soil erosion, salinisation and waterlogging.Methods for valuing the losses, and policies including economic instruments to overcome the problems are discussed.The web resources section provides useful websites on land degradation.

Dr.K.S Kavi Kumar who jointly coordinated a training course on "Cost Benefit Analysis and the Environment" for officials of the Ministry of Environment and Forests, at the Institute for Social and Economic Change, Banglore provides a report on the course.The third article adds another dimension to the ongoing debate on what is a "normal monsoon".We welcome views and suggestions from readers of ENVISAGE.

LAND DEGRADATION DUE TO AGRICULTURE

"All forms of agriculture involve alterations of the ecological system…The challenge is …to direct the interference (of nature) in a way that achieves an acceptable balance between the welfare benefits derived from the productive use of the resource base and the benefits from the preservation of its ecological functions. This is determined by people's needs and preferences on the one hand, and the availability of alternatives on the other. Both preferences and alternatives change in the course of demographic and social transition, demographic progress and economic growth" (de Haen, 1991).

The factors causing land degradation can be generally classified into three. The first set of factors is natural hazards, such as heavy rains and steep slopes leading to soil erosion and arid climates that contribute to salinisation and lowering of the water table. The second category is humanly caused factors; deforestation, overcutting of vegetation, overgrazing, improper crop rotation, non-adoption of soil conservation practices, imbalanced fertiliser use, mismanagement of canal irrigation and overpumping of groundwater. The third factor comprises 'underlying causes of degradation'. These are the basic socio-economic structures that give rise to the direct factors. Among them are land shortage, inappropriate land tenure arrangements, poverty and population growth.

In the process of development, large scale land degradation has occurred in the countries world over. Agenda 21, Chapter 14 of Earth Summit, 1992, rightly highlighted the gravity of the situation, and summed up... " *It is urgent to arrest land* *degradation and launch conservation and rehabilitation programs in the most critically affected and vulnerable areas."* …

India, being vastly agriculture oriented, historically has had policies in various phases to the development of agriculture with the expectation that development of agriculture would lead to overall development of the nation and help eradication of poverty. But the last decade has seen experts voicing concern over the negative environmental effects of modern agricultural practices. The fact that Green Revolution has caused degradation of large scale arable land due to soil erosion, salinity and water-logging is indisputable. Soil degradation in India presents the very real threat of limiting future gains in agricultural output and forest production, as well as risks to human health. However, the diverse factors that contribute to the problem make it necessary that a comprehensive approach is taken by the authorities responsible for policy in different areas such as food security, forests, soil conservation, and water resources.

Intensive farming practices, particularly with wheat and rice in India, have virtually mined nutrients from the soil[1]. Due to heavy use of fertilizers, excess nitrates have leached into groundwater and contamination of groundwater with nitrates has increased dramatically. As such, the cultivable lands have become sick by over-application of chemicals. Apart from over use of chemicals, equally important issue is imbalance in the application of fertilizers and pesticides.

Intensive agriculture has also led to an extension in area under irrigation. In India, area irrigated has doubled over four decades, from 19% to 38% of the net sown area. Much of this increase has come from water extracted from the fast depleting ground water resources. Irrigation is considered as the principal means of water loss from the natural system and it leads to arid condition downstream and ground water depletion. Improper use and maintenance of canal irrigation has contributed significantly to the soil degradation problem. Extension of canal irrigation to arid and semi arid areas has resulted in water logging and salinisation.

Apart from on site costs reflected in the loss of productivity of soil, the off site costs due to agriculture is reported to be quite significant. The off site costs are caused by soil sediments transported in the surface water from eroded agricultural land. These include, river and dam siltation, damage to roadways and sewers, siltation of harbours and channels, loss of reservoir storage, disruption of stream ecology and damage to public health. In addition, by raising stream beds and burying streamside wetlands, sediment can increase the frequency of flooding. The specific crops grown[2] and the cropping practices employed also determine the residuals generated by the erosion and run-off.

According to the National Remote Sensing Agency and Forest Survey of India, 60% of the total area under cultivation is substantially degraded. Most of this damage is in the form of loss of topsoil. An increase in degradation over time is a reality unless relevant policy measures are put to practice to arrest this trend.

Land Degradation as a result of Rational Farm Decision Making

The theoretical studies highlight the fact that the soil erosion is a result of rational farm decision making (Mc Connell, 1983). A rational producer, maximizing the discounted net revenue from land over time would not respond to soil loss until the present value of marginal private returns obtained from additional soil loss goes below the implicit marginal private cost of soil loss. The net value from land consists of two components; the present value of the revenue stream and the present value of the terminal value of the land. Soil erosion, not only affects future productivity but also the terminal value (Miranowski, 1984). The presence of large external cost (off-site costs) is neglected in the private decision. Various types of market failures in the land market have also been noted in the literature. Notable among them are common resource problem, tenurial arrangements, absence of risk market. All these factors

[1] In India, the extent of land area dedicated to foodgrain cropping has grown steadily, from 97 m.ha. in 1951, to 120 m.ha. in 2001, and the total land used for agriculture increased from 140 m.ha. to 170 m.ha.. An additional 12 m.ha. fall under the classification of meadows and pasture. Much of this increment of land over the last four decades has come from previously forested areas, as well as marginal and hill areas.

[2] For e.g. monoculture practice

have bearing on the environmental impacts of land use and hence government intervention is justified.

Complexity in the Measurement of Soil Loss and Sediments

Estimating soil loss is particularly difficult, because of the interaction of many variables, some occurring naturally, such as soil and rainfall. As a result, models, whether empirical or process-based, are complex if they are to include the effects of all variables. For some purposes, meaningful and useful estimates can be obtained from models, and the best example is the estimation of long-term average annual soil loss from arable land, using the Universal Soil Loss Equation (USLE)[3] or Revised Universal Soil Loss Equation (RUSLE) . RUSLE is an attempt to improve the capability of USLE in using dynamic hydrological and erosional processes and the flexibility of USLE in adjusting process parameters to account for spatial and temporal changes. Soil erodability factor method is also one approach to make accurate soil loss prediction. In recent years, there has been a proliferation of mathematical simulation models, based on the various physical processes involved in soil detachment, transportation and deposition.

Estimation of soil erosion has been done for India through some information on soil loss from runoff plots, watersheds and reservoirs[4]. A systematic attempt was made by Singh *et al* (1992) by preparing a country wide map of soil erosion rate. They used the available maps of soil, rainfall erosivity, slope, land use, forest vegetation degraded lands, sand dunes and irrigation. Using this map, they have prepared iso-erosion rate map. The map has been used to estimate the erosion rates for various regions of India.

The extent of salinisation is more difficult to measure than simple soil erosion because the effect of saline soil is underground initially. Further excess quantities of waste also cause a building of soluble salts in the soil. Salts accumulate in the soil when the amounts added in wastes exceed the amounts removed by plant growth, leaching and other means. Eventually, a saline or a saline sodic soil is developed. The worst situation occurs when leaching removes the excess salts but leaves enough sodium to form a sodic soil.

The economic impact of sedimentation of water reservoirs is seen in the following factors: (i)Life span of the reservoir is reduced , (ii) sedimentation causes decreased production (iii) water use requires treatment and (iv) the demand for the complementary sources of water increases.

There are several sources of error associated with trying to correlate the amount of sediment measured in streams with the extent of erosion in the catchment. Measuring the total amount of sediment deposited in ponds or reservoirs avoids the issue of the sediment delivery ratio, but unless the reservoir is large enough to contain the whole of the runoff, some of the sediment will be carried over the spillway. Models designed for the prediction of soil loss are often concerned primarily with the loss of soil from agricultural land, and rarely extended to estimate sediment movement in catchments.

Prevention and Restoration

While soil erosion is an important issue in dry land, salt affected soil and water logging are the major problems of irrigated lands. This causes increasing decline in productivity over the years and finally lead to land abandonment. Problems are aggravating further with more and more new lands being brought under canal irrigation without managing properly the existing lands. On irrigated lands logging problem has to be tackled by better drainage facilities.

Salinity and alkalinity problems are much more aggravated in areas where more than one source of flow irrigation exists, low precipitation, unscientific use of water, improper cropping pattern and drainage facilities. When water use is excessive, the underground water table rises and brings with it dissolved salts from substrata. If the water evaporates and leaves salts caked on the surface , it finally makes the soil useless agronomically. Salts with poor internal drainage facilities are mainly responsible for accumulation of salt in the root zone. There are number of studies that provide estimates of loss in productivity due to salinity and water logging.

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[3]By using USLE, the soil loss is estimated as follows: A = R.K.L.S.C.P; where
A = average annual soil loss , R = rainfall erosivity factor, K = soil erodibility factor, L = slope length factor,
S = Slope steepness factor, C = Cover factor , P = Conservation supporting practices

[4] There is a difference between soil loss from run-off plots and off -site sediment deposition in the reservoirs because of displacement and deposition of sediments within the catchment.

Reclamation is done through gypsum application continuously for three years with reduced application in the second and third years.

While those areas which are already affected require reclamation, preventing further soil erosion is a major task at hand. Integrated Water Shed Management is a major preventive method, which involves soil and water conservation efforts integrated with suitable cropping pattern . It involves constructions such as check dams along the gullies, bench terracing, contour bunding, land leveling and planting of grasses along contours etc. This will increase percolation of water into the subsoil system, reduce surface run off, reduce soil erosion and improve the water availability. Controlling of soil erosion involves maintaining a good vegetal cover on the watershed to prevent sedimentation. Sedimentation can be controlled either by controlling soil erosion or by handling of sediments at the deposits site. The latter is not only expensive but also a very difficult process.

Land degradation monitoring is needed to formulate conservation strategies for the sustainable use of land resources. For identification of potential area for reclamation and land degradation monitoring, Satellite Remote Sensing is found to be a very useful and popular technical tool as compared to other tools like Geographical Information System (GIS) and Global Positioning System (GPS).

Valuation Methods

Loss in the value of soil due to land degradation such as erosion or change in soil quality must be valued in order to understand the environmental cost of agriculture. However it is complex to find soil loss due to agriculture *per se* unless the soil loss due to other causing factors are separated.In the literature, soil loss has been valued using productivity approach, preventive cost approach, and replacement cost approach. The productivity approach basically attempts to value through impacts, viz. estimate soil loss through productivity loss. Preventive measures are factors such as conservation and defensive expenditure. The replacement cost is cost of restoration of soil to its original state.

Using experimental data Repetto *et al*.(1987) has valued soil loss through productivity loss. Econometrics techniques have been utilized in a few other studies (eg. Parikh, 1989; Parikh and Ghosh,1991) to estimate soil loss by writing yield function as separable in input response function and soil quality multiplier function. Given a measurable soil quality multiplier, one can find potential yield value foregone as a result of decline in soil quality for a given input bundle. The concept that farmers adapt their cropping pattern and inputs to alteration in the soil quality can be introduced in the model. Few studies estimate benefits from soil conservation through watershed development program in terms of productivity gains (e.g Ninan, 2002). This can be treated as the value of soil loss by preventive method. Few statistics are also available in a piecemeal manner on costs of reclamation.

Current Status

A recent pioneering study sponsored by three United Nations agencies (FAO, UNDP and UNEP) estimated the severity and costs of land degradation in South Asia. Its finding was that the countries (India, Pakistan, Bangladesh, Iran, Afghanistan, Nepal, Sri Lanka, Bhutan) are losing at least US$10 billion annually as a result of losses resulting from land degradation. This was equivalent to 2% of the region's Gross Domestic Product, or 7% of the value of its agricultural output. Yet this figure is still an underestimate, because it measures only the on-site effects leaving out off-site costs. The interesting part of the study is its assessment of the economic costs of land degradation. Total on-site annual losses were estimated at US$9.8 to 11 billion a year. The breakdown according to types of land degradation was: water erosion US$5.4 billion; wind erosion US$1.8 billion; fertility decline US$0.6 to 1.2 billion; water logging US$0.5 billion and salinisation US$1.5 billion. All India Soil and Land Use Survey under the Department of Agriculture and Co-operation initiated land degradation mapping during the eighth five year plan allowing for the development of district information system for degraded lands. It has so far covered 30 districts located in diversified agro-climatic zones. It has also developed soil information system. Department of Land Resources, Ministry of Rural Development,Government of India has identified different types of degraded wastelands[5] ***(Table 1).*** They prepared Wasteland Atlas of India for the year 2000, with the help of Indian Remote Sensing Satellites. This provides information on districtwise wasteland. These maps help identifying the potential lands for reclamation in the country.

Table 1: Category wise percentage of degraded land as on 2000 as percentage of total degraded land

1.Gullied & or ravinous Land	3.22
2.Upland with or without Scrub	30.40
3.Water Logged & marshy Land	2.58
4.Land affected by Salinity/ Alkalinity-Coastal/Inland	3.22
5.Shifting Cultivation Area	5.50
6.Under Utilized Degraded - Notified Forest Land	22.02
7.Degraded Pastures/ Grazing Land	4.07
8.Degraded Land Under Plantation Crops	0.90
9.Sands-Inland/Coastal	7.84
10.Mining Industrial Wastelands	0.20
11.Barren Rocky/Stony Waste/ Sheet Rocky Area	10.12
12.Steep Slopping Area	1.20
13.Snow covered and or glacial Area	8.73

Note: Total wasteland as a percentage of geographical area is 20.16

Source: 1:50000 scale wasteland maps prepared from Landsat (from Wasteland Atlas).

It is very clear from the above statistics that the land with or without scrub category, which is mainly land affected by soil erosion, records the highest percentage followed by degraded and underutilized forest land. Needless to say, soil erosion is the major problem of land degradation. This was supported by other estimates available for earlier years on soil degradation in India from different sources **(Table 2)** . However there are no reliable information available on type, intensity and severity of land degradation for India. Some estimates on productivity loss due to soil erosion are also available through Bansil and FAO cited in the study by Brandon *et al.* (1995). As per this, the total annual loss in productivity of major crops due to soil erosion is estimated as 7.2 million tonnes . Still , there are no proper estimates available by break up of causes of land degradation.

Table 2: Soil Degradation Statistics (area in million ha)

Type	Ministry of Agri. & Co-operation		Sehgal and Abrol	
	1980	1985	1994	1997**
Soil erosion*	150.0	141.2	162.4	167.0
Saline and Alkaline soil	8.0	9.4	10.1	11.0
waterlogging	6.0	8.5	11.6	13.0
Shifting cultivation	4.4	4.9	-	9.0
Others	-	11.1	9.1	12.2
Total degradation	168.4	175.1	175.0	187.8

**Source: TERI Report No: 97/ED/52

* *This includes both wind and water erosion , but water erosion accounts for more than 90%.*

A rough estimate of soil erosion and sedimentation for India reveals that about 5300 million tonnes of top soil are eroded annually and 24% of this quantity is carried by rivers as sediments and deposited in the sea, and nearly 10% is deposited in reservoirs reducing their storage capacity by 2%.

As for water logging and salinisation, the available estimates show that canal command area constitutes 48% of the total water logged area, and 45% of the total salt affected area in India. In fact for a few states like Andhra Pradesh, Tamil Nadu, Orissa, Punjab and Gujarat, canal irrigated area occupies 100% of the total water logged area.

The Soil and Water Conservation Division in the Ministry of Agriculture has taken initiative in the implementation of integrated watershed management programs. These programs are planned to cover 86 million hectares, of which 26 million hectares (27 river valley catchments and 8 in flood-prone rivers) in highly critical areas have been assigned priority under 35 centrally sponsored projects. In addition, over 30,000 hectares of shifting and semi-stable sand dunes have been treated with shelter belts and strip cropping as a conservation measure (TERI Report, 1997).

In 1985, National Land Use and Wasteland

[5] The Technical Task Force Group constituted by Planning Commission and National Wastelands Development Board categorized wasteland as " Degraded land which can be brought under vegetative cover with reasonable effort and which is currently under-utilised and land which is deteriorating for lack of appropriate water and soil management or on account of natural causes."

Development Council was constituted, former in the Ministry of Agriculture and the latter in the Ministry of Environment and Forest.[6] The objective was to formulate a National Policy and Perspective Plan for conservation and management of land resources, appropriate land use given the soil capability. Some reclamation work was carried out as part of wasteland development task. ***Annexure I*** gives more details on policies and programs related to land use and conservation in India.

Problems from the Policy Perspective

Though intensive agricultural practices are mainly held responsible for land degradation, the problem could be overcome to an extent by suitable policies that internalize degradation in to producer decision making wherever possible. Rather wrong policy choices have aggravated the problems; to mention a few, zero or subsidized pricing of electricity for tubewell irrigation, heavily subsidized surface water for irrigation and subsidized chemical inputs. For example, overuse of poor quality tubewell water has led to soil salinity. Economic instruments in the form of incentives will be a cost effective measure to encourage farmers to adopt soil conservation practices. For problems regarding over application of chemical inputs, in the long run, conjunctive use of chemical inputs with bio inputs along with farm residues is desirable.

The information base on which farmers make decisions is incomplete with respect to internalizing rapid changes in soil and water quality variables by moving to more sustainable practices such as integrated pest management, more land conservative crop rotations. Research has to focus more on sustainable practices such as integrated crop management. An integrated approach to the problem of degradation linking agriculture and environment is yet to be attempted even though at the policy level it has been stressed.

The existing land use policy failed to bring right results due to lack of coordinated approach to different components of agriculture such as soil , water and other inputs. While legislations to protect resources such as forest Conservation Act, Biodiversity Bill have been passed, no such legislation exists exclusively for soil related problems. Though Soil Conservation in arid, semi arid and dry sub-humid areas had been included as one of the themes in the international convention on 'Combating desertification' in 1996. India participated and ratified its commitments. The objective was to curtail the wide scale deforestation and water shed degradation through appropriate measures. In India, The Soil Conservation Programs have been mostly confined with Agriculture Departments, and the aim was to educate the farmers with various conservation practices. But so far the programs did not meet with success due to the absence of participatory approach.While more attention has been paid to issues such as forest land conversion to agriculture, which is related to extensive cultivation, not much has been thought about degradation due to intensive cultivation practices of the existing land. Recently MoEF has initiated efforts to address this issue. Often action on these issues conflicts with agriculture development in the short run.

Farm research should address on balancing of external inputs use and internal sources of nutrients. Thus from a policy perspective, there is a need for public and private initiative on several fronts- increased investment in resource management, research and extension, research to develop suitable and more sustainable cropping patterns and rotations, correction of price distortions on key inputs, especially water and electricity, and special incentives to invest in bio inputs and also inputs like gypsum that helps reclamation of salt affected soil. Such policy interventions may be rewarding if they can counteract the environmentally perverse land use. However, costs of such interventions have to be considered against potential benefits, before making definite policy prescriptions.

In this context, linking up ecological processes with economic activities becomes significant to ensure community participation in eco-restoration and for sustainable agriculture.

[6] As per VIIth Schedule of the Constitution, states are empowered to develop policies and enact laws. In India, conservation and management of land resources rest with three Ministries ; Ministry of Rural Development, Ministry of Agriculture and Ministry of Environment and Forest. At the national level, the Department of Land Resources under Ministry of Development is the nodal agency for coordinating different land resource development and management programs.

Limitations of sectoral policies and institutional mechanisms in dealing with the complexity of the eco-restoration are now being recognized. The problem of land degradation can only be tackled when the totality of the soil-water-plant-animal-human interactions in the system is synergised through appropriate policies.

G. Mythili, MSE

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 # About 70% of the total cropped area experiences nutrient depletion of more than 50 Kilogram per hectare annually.

 # The annual depletion of major nutrients (nitrogen, potassium and phosphorous) is to the tune of 5.8 mt per year.

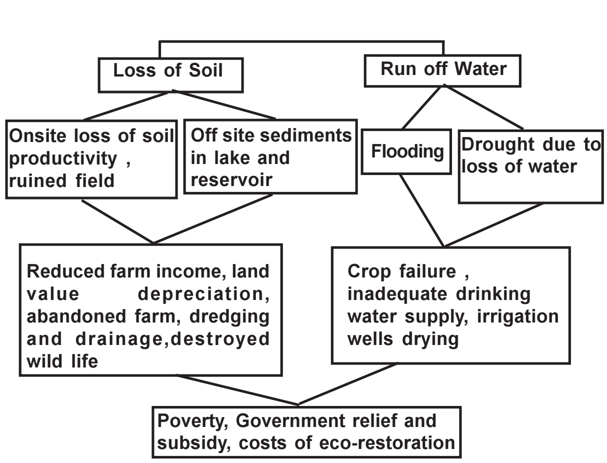
 # An all - India study on the status of micronutrients in soil collected 2.5 lakh soil samples from 20 states.It found a staggering 47% of the samples deficient in Zinc.

Annexure I

Policies /Programs that have a Bearing on Land Resource Use

Year	Programs/Policies	Specific Features
1977-78	Desert Development Program	Restoration of ecological balance by harnessing,conserving and developing natural resources
1985	National Land Use and Conservation Board	Formulate a national policy and perspective plan for conservation, management and development of land resources of the country Review of progress of implementation of ongoing schemes and programs connected with conservation and development of land resources and soils
1985	National Wastelands Development Board	Formulate a perspective plan for the management and development of wastelands in the country identify the waste land and assess the progress of programs and schemes for the development of wasteland create a reliable data base and documentation centre for waste land development
1988	National Land Use Policy	To devise an effective administrative procedures for regulating land use to prevent further deterioration of land resources restore the productivity of degraded lands allocate land for different uses based on land capability,productivity and goals
1989-90	Integrated Wastelands Development Project	adopt soil and moisture conservation measures such as terracing ,bunding etc... enhance people's participation in wasteland development programs
1992	Constitution (74th Amendment) Act, 1992	Regulation of land use and urban planning brought under the domain of urban self - governing bodies
1999	Department of Land Resources	Formulation of Integrated land resources Management Policies Implementation of land based development programs

Figure 1 : Economic Impact of Soil Erosion



Cost Benefit Analysis and the Environment

Cost benefit analysis (CBA) may be defined as a set of analytical procedures for measuring and comparing the benefits and costs of a project or policy. The CBA can be used to assess whether the total benefits of a project exceed the total costs. The principal purpose of CBA is to inform the decision-making process, and it can be used in conjunction with other decision support tools such as, Environmental Impact Assessment (EIA) or Multi-criteria Analysis (MCA), to reach a decision.

Cost-benefit analysis is similar in form to the conventional financial analysis of projects. However, while financial analysis limits its focus to project-operating entity, the cost-benefit analysis is concerned with the effects of project on the society as a whole. For valuation of the effects of the project CBA employs the notions of willingness-to-pay (WTP) and willingness-to-accept (WTA) compensation. These measures are considered appropriate compared to the market prices because:

- The prices in the market could be 'distorted' due to government interventions.
- The project effects could be non-marketed (e.g., biodiversity), or incompletely marketed (e.g., water supply,sanitation).

CBA employs so-called 'shadow prices' to estimate WTP and WTA compensation values when markets are distorted or absent. With respect to environmental resources – which are typically non-marketed - shadow prices are estimated using some of the specialized valuation techniques developed in the field of environmental economics (e.g., travel cost, hedonic pricing, contingent valuation).
Application of CBA to environmental management introduces a number of conceptual and procedural concerns, such as:

- The valuation of non-market goods, such as wildlife and landscape: how should this be done, and how much reliance should society place on estimates so generated? Are we acting immorally by placing money values on such things?
- Ecosystem complexity: how can society accurately predict the effects on an aquatic ecosystem of effluent inputs?
- Discounting and discount rate: should society discount? If so, what rate should be used? Does discounting violate the rights of future generations?
- Uncertainty and irreversibility: how will these aspects be included in a CBA?
- CBA *vs* CEA: if benefits cannot be monetized should the decision maker put emphasis on cost effectiveness analysis (CEA)?

While it cannot be asserted that CBA can deal effectively with all these concerns, it must also be kept in mind that CBA is a powerful tool that could be used well with appropriate modifications by the public policy makers dealing with environmental management. With this background the Center of Excellence in Environmental Economics at Madras School of Economics organized a three day workshop on "Cost Benefit Analysis and the Environment" for the Officers of the Ministry of Environment and Forests, Government of India during June 2-4, 2003 at Institute for Social and Economic Change, Bangalore.

After the inaugural lecture by Prof. G. Thimmaiah, Former Member, Planning Commission, GoI that emphasized the need for sensitivity analysis the workshop started with an overview lecture by Prof. U. Sankar, Madras School of Economics. This and the following lecture by Dr. Kavi Kumar of MSE on the first day of the workshop provided the conceptual background for the CBA technique and the environmental valuation techniques. The remaining lectures focused on case studies and these included lectures by Dr. G.S. Sastry of ISEC on Waste Water; Dr. Gopal Kadekodi on Mineral Resources; Dr. Madhu Verma on Wetlands; Dr. K.N. Ninan on Watershed and Social Forestry; and Dr. Paul Appasamy on Solid Waste Management. Besides the lectures the workshop also included a field visit to Urban Waste Water Treatment Plant in the afternoon session of 3rd June 2003 and a Panel Discussion in the afternoon session of 4th June 2003. The Panel Discussion involving some of the above mentioned resource persons and Dr. P.J. Dilip Kumar of Karnataka Forest Development Corporation and Dr. K.V. Raju of ISEC focused on applicability of CBA to projects/policies with environmental dimensions. About seventeen officers from MoEF, CPCB, and their regional offices attended the workshop. As many as nine resource persons involving faculty members at MSE, ISEC and other reputed institutes in India participated in the workshop. Dr. K.S. Kavi Kumar of MSE and Dr. G.S. Sastry of ISEC coordinated the workshop.

Participants at the Workshop on " Cost Benefit Analysis and Environment" for the Officers of the Ministry of Environment and Forests, Government of India held at Institute for Social and Economic Change , Banglore during June 2-4.

What is a "NORMAL" Monsoon?

The rainfall in the month of July constitutes a major component of the overall monsoon rainfall in India. The monsoon behavior is so peculiar that the monsoon forecasting remains as one of the most difficult tasks despite the advances in modern technology.

The India Meteorological Department (IMD) based on a power-16 regression model makes the predictions. Since the predictions matched reasonably closely with the actual performance of the monsoon during the period 1997 to 2001 ***(see Table 1)*** the performance of IMD model was considered adequate. However, with last year's predictions going awry the IMD was compelled to adopt a new 8-parameter power regression model. Based on this model IMD predicted that the rainfall in 2003 monsoon season (July – September) for the country as a whole is likely to be 96 per cent of the Long Period Average (LPA) with a model error of ± 5 per cent.

A pertinent question that needs to be asked is: Do monsoons really make a difference to Indian agriculture and Indian economy? The monsoon rainfall has significant effects on the Indian economy with the impacts stretching well beyond rural economy. Poor rainfall may result in fall in agricultural production and lead to slow down of the GDP growth due to a reduction in the demand for manufactured goods. However, while assessing the impact of monsoon on Indian economy it is essential to probe beyond the aggregate measures of monsoon rainfall. For instance during the years 1999, 2000 and 2001 about 67 per cent of districts received normal/ excess monsoon rainfall ***(see Table 1)***. But agricultural GDP growth during these three years has been 0.3, - 0.4 and 5.3 per cent, respectively ***(see Table 2)***. During 1999 monsoon there was deficient rainfall during the agriculturally crucial first half of the monsoon season. Similarly during 2000 the post-monsoon (October-December) rainfall was deficient in as many as 31 (out of 35) meteorological sub-divisions. These factors could have contributed to poor performance of agricultural sector despite 'normal' rainfall predictions and actual rainfall received. In 2001, on the other hand, the rainfall was spatially well distributed compared to previous seven years and this reflected in the good performance of agriculture (5.3 per cent growth).

In sum, to label a monsoon as 'good' one it is not sufficient to just look at overall measures and it is essential to probe about its spatial and temporal performance as well.

Table 1: Monsoon Performance - 1998 to 2002
S-W Monsoon (June – September)

Year	Normal	Excess	Deficient/ Scanty	% of district with normal/ excess rainfall	% of LPA for country as a whole predicted by IMD	Actual % of LPA
1998	20	13	2	81	99	106
1999	25	3	7	67	108	96
2000	23	5	7	66	99	92
2001	29	1	5	68	98	92
2002	14	1	21	44	98	81

Table 2: Growth rate of Agricultural and Overall GDP (percent)

Year	GDP	Agricultural GDP
1998 -99	6.5	6.2
1999-00	6.1	0.3
2000-01	4.4	-0.4
2001-02	5.6	5.3

Source *: Economic Survey 2002 – 2003.*

Web Resources on Issues relating to Land Degradation

http://www.ecnc.nl/doc/lynx/
- Bibliography on Land Management and land use related publications.

http://www.nrcs.usda.gov/technical/worldsoils
- For compendium on issues relating to land degradation and soil erosion.

http://www.eoc.csiro.au/aciar/soilenvir/
- For information on soil assessment for mapping sustainable agriculture.

http://users.aber.ac.uk/jld1/Impact/soil_degradation.htm
- For information on causes and effects of soil erosion.

http://www.eco-portal.com/land/threats/
- For latest headlines on global land conservation and sustainability.

http://www.geographyhigh.connectfree.co.uk/s5rldegradation.html
- For discussion on issues relating to rural land degradation, desertification and watershed management.

http://www.wri.org/trends/soilloss.html
- For discussions on issues relating to land degradation, Soil loss and environmental impacts.

http://topsoil.nserl.purdue.edu/nserlweb/usle/
- For Database on USLE (Universal Soil Loss Equation), soil loss and soil runoff data.

Excellence is not a destination , it is a continuous journey that never ends...

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